ANALYSIS OF THE EXCHANGE RATE VOLATILITY INFLUENCE ON THE SHARE PRICE: MOROCCO, AS CASE STUDY

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Abstract: *The main objective of this article is to check and measure the exchange rate volatility impact on the share price of Moroccan companies listed on the Casablanca stock exchange by using the Vector Error Correction Model. We have got poor results in accordance with the exchange rate Puzzle. However, these results were significant, which confirms the relation between exchange rate volatility and share price. Also, we found out that factor such as the firm size, the business sector and the foreign involvement degree stimulate the exchange rate volatility effect. We have also observed a greater sensitivity toward international currencies compared to exotic currencies.*
Keywords: *Ccurrency Risk Management, Economic Exposure, Exchange Rate Puzzle, Exotic Currency, Exchange Rate Volatility.*

INTRODUCTION

Nowadays, the dirham spreads panic among finance professional creating an endless controversy within mainstream media. The hesitant monetary authorities wanted to liberalize the Moroccan currency in the second quarter of 2017 before postponing this measure until 2018; meanwhile, researchers are wary about the relevance and the consequence of such initiative. Shareholders, which their main goal is to maximize the value of their firms, can use this paper to get more reliable information susceptible to prevent companies from foreign exchange risk. Financial literature has not delivered a clear and definitive opinion on the impact of exchange rate volatility on the productive fabric, that’s why which compelled researchers use words like "exchange rate puzzle" to define the contradictory results of previous studies.

The originality of this work arises from the absence of profound studies in this field in morocco due to lack of specialists and publications in currency risk management. Besides, the status of the dirham as an exotic currency on a worldwide scale separates our paper from t he similar scientific productions of foreign countries. In addition, we also include in our sample domestic companies, which will give us a wide view on the effect of exchange volatility on this poorly studies category. Unfortunately, the phenomenon of exchange volatility is polysemous. As a matter of fact, we opted for the definition of Marston (1988) "there are two types of

exchange rate variability, volatility and misalignment volatility of exchange rates. Misalignment, in contrast, is the persistent departure of an exchange rate from its long run competitive level"[1].

Indeed, this article aims to prove that the volatility of foreign exchange is an exogenous variable that explains the stock market value of company. In other words, we will measure the way in which shareholders estimates the management style of exchange risk by the managers of the company. In addition, this research could be served as a basis for other studies that will deal with the impact of a possible exchange liberalization in morocco or the possible entry into a economic zone " such as CEDEAO" especially with the recent convertibility easing of the dirham by the exchange office.

REVIEW

The financial literature on stock price exposure to currency volatility is abundant. However, empirical works, which dated back mainly to 1980 s, don't offer a final answer to this problematic in spite of modern statistical tools accumulated throughout time. Moreover, results varied depending on the country and the period of the study. Alder and Dumas (1984) were among the first researchers who focused on this subject by analyzing the sensitivity of American companies to the fluctuations of the dollar. They have distinguished the founding concepts of this discipline "exposure, risk …" they have also proposed the first measurement model based on linear regression.

Then, Jorion (1990) found that only 15 out of 287 multinational corporations (American) have significant yield correlated with the exchange rate variability. Bodnar and Gentry (1993) worked on industrial firms in Canada, Japan and United States. They found that 30% of their sample is threatened by exchange volatility by relying on iterative variables. In addition, they have distinguished between an importing firms corresponding to positive correlation with the exchange rate fluctuation. In contrast, the share of an exporting company is negatively related to the exchange rate movement.

Unfortunately, the determination of exposure sign has become more complicated for companies that perform both export and import transactions because according to Lin (2011) it depends on the competitive position of the firm on the input/output and assets. It should be noted that the most of the empirical works mentioned anomalies concerning the theoretical exposure sign. In addition, He and Ng (1998) remarks that 25% of the Japanese companies in the study were subject to instantaneous exchange rate fluctuations. The same goes for Martinez- Solano (2000) who noted that 11, 06% of Spanish companies are concerned with exchange rate volatility.

Moreover Aggarwal and Harper (2010) were interested by domestic companies. They have studied 1047 American companies in this category. They noted that a significant proportion is sensitive to currency fluctuations (10%-15%) for monthly data, sometimes to the same extent as firms with international transactions. This result matches the findings of Choi and Jiang (2009). Besides, Aggarwal, Chen and Yur-Austin (2011) observed that less than (10%) of the

1 Razafindramanana, O.M., 2015. *Variabilité du taux de change, flux commerciaux, croissance économique: le cas de Madagascar.* Universite de Pau et des Pays de l'Adour., pp.112

Chinese companies in 19 business sectors were sensitive. They also reported a change of exposure sign after the revaluation of the Chinese Yuan in 2005.

Francois Varga (2012) has studied Taiwanese firms with a more elaborate model. He found that 88.57% of companies have a daily return sensitive to exchange rate with a sensitivity of 12.38% at a 10% level of significance. In contrast, only 63.73% of the sample with monthly return is exposed with a coefficient of 5.88%. He concluded that small exchange rate variations can affect the monthly return of 94% of companies against 88% for those with daily return. He also outlined that small economies are more threatened by currency risk.

Furthermore, Demirhan and Atış (2013) detected a foreign exchange exposure of the entire textile sample for at least one of the sub-periods "22 companies", of which 40% is sensitive to the Dollar and the Euro at the same time reflecting the complexity of the sector's competitive environment. A more instructive study came out thanks to Du, Ng and Zhao (2012). Based on the Jorion model, they realized that 20% of businesses are exposed to exchange rate fluctuations. However, this percentage reached 87% when using the quantile regression techniques. Furthermore, the food processing industry, where the big part of turnover is made through export was not affected according to the conventional method. However, the impact is negative when using the quantile regression. The main business sectors that have a positive sensitivity are transport, distribution, book publishing and textile, which imports raw materials. Though, agriculture, electronics, tobacco and mining are exposed with negative signs since they carry out massive exports.

Very few studies have included Morocco in their samples. We cite Ye, Huston and Muckley (2014) that processed data from 1999 to 2010 for 1523 companies including 28 Moroccan among them 29% with negative exposure trends. On the other hand, several works like Amihud (1994) and Häberle (1999) didn't succeed in giving significant results that confirm the relation between currency volatility and stock price.

The explanation of the relation between volatility of exchange rate and share price is mainly based on informational efficiency concept that was developed by Fama (1969). Indeed, the perfect stock market price reflects information (public or non-public) about any giving share. This facilitates the orientation of public savings towards the most profitable assets, taking into account the associated risks. The currency volatility can be useful information at this level.

In accordance with the market efficiency theory, some stock markets do not immediately include financial information in share's price. This also applies to the exchange problem. Moreover, Bodnar and Bartov (1994) are pioneers in this filed because they decreed the absence of correlation between the volatility of the dollar with the performance of contemporary shares yield. During this period, the relationship is significantly established between these variables decaled manner. Wu and Zhou (2011) noted that the number of electronic firms exposed with a delay effect for exceeds those exhibited with a contemporary effect.

Roll and Ross (1976) has also developed the Arbitrage Pricing Theory model stating that the stock market price is the linear combination of several factors affecting the performance of the company, most likely, the currency risk. Unfortunately, these authors didn't specify the factors nor the nature of the relationship, leaving it to market operators. Likewise, Du and Hu (2014) studied the valuation of cash-flow sensitive to exchange rate volatility in the stock market. To understand this phenomenon, they used the factor mimicking portfolio method inspired by the Fama and French (1993) model. They noted that 30% of assets are related to the

exchange rate because of constituting various portfolios where some are fragile to the exchange movements and others are not concerned by this.

In contrast, Krapl and O'Brien (2015) analyzed the sensitivity of the earning by share (EPS). Using the spearman Technique, they found a low significant correlation between the exposure coefficients and those of the EPS. Furthermore risk-free bonds as a controlling variable provide better results in comparison to other models. This kind of discrepancy could be explained by information asymmetry. Häberle (1999) suggests that managers are more aware of the consequences of exchange rate volatility. Another reason, that is relevant in the literature, is the share exposure captures the expected future cash flow that is lower than that which is realized Martin and Mauer (2003). This is the case where cash flows are affected in the short term while being insensitive in the long term.

Another concept appears "Moral Hazard Hypothesis" Burnside et al (2001) Chang and Velasco (2000) Eichengreen and Hausmann (1999) Schneider and Tornell (2004) to qualify the behavior of companies that who consider the pegged exchange rate as an implicit guarantee of the state and therefore they take more risk by getting overmuch foreign currency debts or by having bad deals with creditors. The companies do not care about the currency hedging in the pegged exchange regime Kamil (2006). For example, Parsley and Popper (2006) have confirmed a high exposure to the movement of the dollar in the Asian stock market, Indonesia, Korea, Philippines, Malaysia, Taiwan and Thailand, where the exchange rate regime was fixed but also in terms of number of companies for the last three countries. Also, Patnaik and Shah (2010) reported the same remark on shares of the 100 most liquid Indian Companies during the period when the exchange rate was less flexible.

The explanation of the relationship between exchange volatility and price of the share also comes from the link between interest rates and the basics of the economy "inflation rate and exchange rate which gives this risk a systemic dimension". On one hand this is formalized by Uncovered Interest Parity (UIP) which considers that the instability of the interest rate is the cause of the currency exchange rate fluctuations. Which react at maturity to neutralize the risk-free returns via capital inflows and outflows Hissler Sebastien (2007).

Contrary to what preceded, the exchange rate may become the cause of movements in interest rates. For example, an anticipated depreciation of the currency weakens the demand for domestic bonds, which forces the government to raise the national interest rate to compensate the losses which suffer investors such as the Mexican Peso Crisis Tovar -Silos (2015). It should be noted that several works deny this relationship Calvo and Reinhart (2012), Meredith and Chinn (2005) that's why some researchers qualify the contradiction between the theoretical and practical part by "exchange rate disconnect Puzzle".

On the other hand, the exchange rate is linked to inflation by the Purchasing Power Parity discovered by Cassell (1925) which is also a systemic part of this risk. At this level, the movement of exchange rate is no longer the cause of price variations, it is the mere reflection or response to inflationary mechanism as well, as the unexpected increase in inflation causes depreciation of the currency. Of course, the sensitivity degree of shares differs from one company to another. This is why researchers have shed light on several factors guilty of this disparity:

Firstly, the degree of foreign involvement favors the sensitivity to currency volatility. Jorion (1990) and Nydahl (1999), Allayannis and Ofek (2001) have supported the link between the

export rate and the intensity of exchange variation effects, unlike Chow, Lee and Solt (1997) who rejected it.

Secondly, the use of financial instrument reduce currency exposure according to Nydahl (1999), the hedging level of firm contribute to the exacerbation of share volatility. Moreover, Mahar and Huffman (2001) discovered a more visible delay effect in companies that rarely utilize currency hedging instruments.

Thirdly, Chow, Lee and Solt (1997), Bodnar and Wong (2003), Dominguez and Tezar (2006), Huston and Stevenson (2010) point out the size of the company as an explanatory factor. Indeed, big companies have technical skills and specialized staff capable of managing the currency risk. Moreover, this category has the capacity to realize economies of scale.

METHODOLOGY

This study has respected the essential steps of the methodology. We start by specifying concepts then variables of the model. After that we use previous academic work to identify the direction of the relation. Subsequently, we discussed the definition of the population. It covers all companies with Dirham-denominated capital whether they are exporters, importers or domestic. As for the constitution of the sample we've selected all the companies introduced in the stock market of Casablanca before 31/12/2008 and active in this market until 31/12/2015. We mention that 7 firms were excluded from the study due to the lack of data or they had economic crises. In total, we select a sample of 58 Moroccan companies providing monthly data of up to ten years (01/01/2006 to 31/12/2015). That is to say between 72 to 120 observations per company.

As for data collection, we have selected the end-month share prices and Moroccan all shares Index "MASI" from the Casablanca stock market administration. Furthermore, we have determined the foreign currency exposure with the help of specialized newspapers and professional websites. In fact, we used the month-end exchange rates of 10 currencies from the official web site of the central Bank of Morocco. http://www.bkam.ma/Marches/Principaux-indicateurs/Marche-des-changes/Cours-de-change/Cours-virement-moyen-de-fin-de-mois And a single currency from trading Canadian Forex: http://www,canadianforex,ca/forex-tools/historical-rate-tools/historical-exchange-rates.

We note that we have transformed the Dirham quotation to the uncertain quotation. Even we have collected the weighted average rates of treasury bonds at maturity of 13 weeks which we assimilated to the risk free rate http://www.bkam.ma/Marches/Principaux-indicateurs/Marche-obligataire/Marche-des-bons-de-tresor/Marche-primaire/Taux-moyens-ponderes-mensuels-des-emissions-du-tresor?startMonth=1andstartYear=2006andendMonth =12andendYear=2016andblock=f93d86e8efc6f73bf329cf984d12deb5

It should be noted that we have encountered rare missing values in Treasury bonds and the exchange rate. As a result, we preferred removing observations method because it doesn't create artificial correlation. In order to eliminate spurious regression we opted for the Vector Error Correction Model "VECM", which was developed by Johansen (1988, 1991). In fact, we propose the following equation:

$$\Delta Y_t = C_0 + \pi Y_{t-1} + \sum_{k=1}^{p}\left(\sum_{i=1}^{p'} B_i{}^k X_{t-i}^k\right) + \varepsilon \quad \textit{Eq. (1)}$$

With

$$\pi = \sum_{i=1}^{p'} A_i - 1$$

Y_t: price share at the end of the month.
C_O: constant.
X: exchange rate at the end of the month.
B: coefficient of sensitivity.
M: cointegration relation.
k: number of currencies
i: time difference.
ε: residue.

First of all, we applied the augmented Dickey Fuller test for time series. We have chosen the Akaike information criterion AIC in order to determine the number of delays. Moreover, we used the trace test λ_{trace} based on the log-likelihood ratio. So we suppose that we have an intercept and no trend in cointegration.
Of the second equation we introduce two control variables to better measure the extent of the phenomenon.

$$\Delta Y_t = C_0 + \pi Y_{t-1} + \sum_{i=1}^{p'} Q_i Z_{t-i} + \sum_{i=1}^{p'} G_i M_{t-i} + \sum_{k=1}^{p} \left(\sum_{i=1}^{p'} B_i{}^k X_{t-i}^k \right) + \varepsilon \quad : \textit{Eq. (2)}$$

z_{t-i}: free risk rate
M_{t-i}: MASI at the end of the month.
Q_i etG_i: coefficient of sensitivity.

RESULTS

The following two tables summarize the most important results:

Table 1: Direct exposure to exchange volatility Eq (1)

	Company	Currency	R Adjusted	Coefficient	Signe	Category
1	SNEP	Euro 2	0.297455	23627.98	Positif	Exporter
		Dollar 1		12666.36		
		Dollar 2		15452.90		
2	BCP	Cfa -3	0.121134	187.2977	Positif	Exporter
3	DARI	Euro2	0.103164	85750.47	Positif	Exporter
4	CTM	Cfa -1	0.057006	26.61866	Positif	Exporter

Average	0,14468975	22951,937		

we use the ordinary least squares method. Coefficients are significatifs at T Student.

Referring to the first model with a margin error of 5%, we observed that four companies had significant correlation between exchange rate volatility and price share on a sample of 58 companies so the percentage is 6.89%. This model measures the total exposure of the firm including the systemic part and the idiosyncratic part which evaluates the way that the company manages the currency risk. So the exchange rate volatility explains 14,46% of the price share variation of these companies with a standard deviation of 0,0763. As for the coefficient of the exposure, we have found an average of 22951,93 where all firms have export activities and a positive coefficient that contradicts financial theory. We also mention a high standard deviation of 21158,19.

On the other side, we found that only three out 11 currencies have a visible effect on the share prices. Two of them have an international character "Euro, Dollar" and one exotic currency "CFA" which reflects the nature of Moroccan commercial relationships with the outside. In addition, we noticed that the delay effect is more important in comparison with the contemporary effect. In other words, Casablanca stock market has a long memory.

We note that we have adopted Chow Test for Structural Stability for these companies by taking breaking point December 2009. This corresponds to the recovery period after the shock of the financial crisis. This test shows the similarity of the results of the two sub-periods. Therefore, the hypothesis of non-linearity of the currency volatility relation with price share should be discarded. So, the operator behavior in the market is the same at this level.

Table 2: Exposure to exchange volatility by using control variables Eq (2)

	Company	Currency	R Adjusted	Coefficient	Signe	Category
1	SNEP	Cfa 2	0.4015	47.22492	Positif	Exporter
		Cfa 3		43.28872	Positif	
		Euro 2		-42670.53	(Negatif)	
2	SAADA	Euro 1	0.3889	-21198.00	(Negatif)	Exporter
		Aed 1		-12877.81	(Negatif)	
3	CIH	Euro 1	0.2128	-53946.14	Negatif	Domestic
		Dollar 1		-9169.741		
		Dollar 2		-5816.422		
4	AUTONEJMA	Dollar 1	0.1668	34613.01	(Positif)	Importer
		Dollar 2		29315.29		
5	CREDIT DU MAROC	Dollar 2	0.1344	-3399.987	Negatif	Domestic
6	MAGHREB OXYGENE	Euro 1	0.1329	23367.62	(Positif)	Importer
Standard deviation			0,0779	19138,75		

we use the ordinary least squares methods. Coefficients are significant at T student, the quotation marks () mean that the sign conforms to the literature.

With regard to the second model, we found 6 companies had a correlation with the exchange rate volatility, 10% of our sample with a margin error of 5% moreover the exposure

coefficients are clearly superior to the first model also the R adjusted increases while it still weak. As a result, we deduce that the second model is better adapted to our problematic. The main cause of the results improvement is the introduction of controlling variables.

On the other hand, we can say that four companies were exposed to the exchange rate volatility with coefficients sign in accordance with the literature which represents 6,89% of our sample. In this case, we have important coefficients exposure coefficient ranging from negative 53946,14 to positive 34613,01. Furthermore, 4 currencies among 11 are concerned with our problematic to know the Euro, CFA, Dollar and the Arab Emirates Dirham. Here again, we recall the international currencies are more present. However, the delay effect is less acute compared to the contemporary effect in this model.

We also used for the 6 companies the Chow coefficients stability test by taking for breakpoint December 2009. In fact, the results indicate the linearity of the link exchange rate volatility – price share overtime. The profile of companies concerned by the exchange rate variation is completely different from the first equation because we notice importing, exporting domestic companies, which makes this model more credible. On the other hand, all the firms are of medium size. This raises several questions about the quality of currency risk manage ment for SMES.

Moreover, all the companies in the chemical sector "Maghreb Oxygene and SNEP" are exposed to exchange rate volatility, especially the last company involved in both models. We believe that the structure of the chemical industry sectors favors sensitivity to the exchange rate variation since this market is open to international trade. Moreover the competition in this industry is based on the price.

In addition, we note that the banking sector is also affected by the exchange rate phenomenon whether they are domestic banks "Credit du Maroc and CIH" or international "BCP in the first equation" which is normal based on the fact that they play the role of risk Taker while other banks are not subject to the exchange rate volatility "BMCI ATTIJARI and BMCE". Besides, some sectors must be sensitive "Distribution, Tourism and Mining" but they are not influenced in reality by Dirham variations. In total, we have 9 companies with a price share sensitive to foreign exchange it represents 15.50% our sample of Moroccan companies benefited from pegged exchange regime indeed, we believe that a future liberalization of the Dirham can increase the perimeter and correlation coefficients.

It should be noted that the results reported in this study are significantly inferior to those of "Ye, Huston and Muckley (2014)" we think that this is due to the differences in margins of error adopted in the two articles. However, these results go along with previous studies that showed a weakness of the relation exchange rate volatility / price share.

The weakness of the empirical results can be explained or one side by the agency theory of Jensen and Meckling (1976) which states that managers are more aware of the consequences of the exchange rate volatility on the company compared to shareholders. On the other side, the informational inefficiency of the Casablanca stock market has been approved in various studies like Khattab and Moudine (2014) which adversely affects this risk valuation. And finally, the pegged exchange regime in Morocco softens the shocks of exchange rate volatility or changes the market participant behavior.

CONCLUSION

In light of what has been said above, we deduce that the exchange rate volatility has a significant effect on the price share. The results obtained are low according to the exchange rate puzzle dichotomy. We went through the main academic works in this field. Unfortunately, most of them are held in developed countries with weak or contradictory results.

Our analysis covered 58 Moroccan companies listed on the Casablanca stock market for the period from 01/01/2006 to 31/12/2015. Thanks to VECM model, we have found, that 9 firms were significantly correlated with exchange rates. The profile of these firms is consistent with the idea that the degree of foreign involvement, size and industry structure stimulates the relationship between price share and exchange rate volatility. Besides, we have noticed a greater sensitivity to international currencies in comparison with the exotic ones. We suppose that the weak results of this research are due to lack of informational efficiency in the Casablanca stock market, the pegged exchange regime or the information asymmetry between shareholder and manager.

Accordingly, we suggest a deep study on the contribution of the Moroccan forward exchange market to limit the effect of exchange volatility. We also recommend a thorough simulation of the effects of liberalization of the Dirham.

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APPENDICES

Table 1

	Company	Coefficients on the error correction term
1	SNEP	-0.081345
		-38.39545
2	BCP	-0.002115
3	DARI	-0.010617
4	CTM	0.005113

Table 2

	Company	Coefficients on the error correction term
1	SNEP	-0.02191
2	SAADA	-0.026502
		-1124.606
		-0.001852
		24671.21
		-1221.712
3	CIH	-0.038954
		-3050.247
4	AUTONEJMA	-0.16684
5	CREDIT DU MAROC	-190.2332
6	MAGHREB OXYGENE	-0.019971

Dickey-Fuller test of some currencies
Null Hypothesis: D(EURO) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on AIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.175174	0.0000
Test critical values:	1% level	-4.069631	
	5% level	-3.463547	
	10% level	-3.158207	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EURO,2)
Method: Least Squares
Date: 03/04/18 Time: 20:48
Sample (adjusted): 2006M04 2013M04
Included observations: 85 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EURO(-1))	-1.103573	0.178711	-6.175174	0.0000
D(EURO(-1),2)	-0.192494	0.111355	-1.728650	0.0877
C	-0.000114	0.000148	-0.775040	0.4406
@TREND("2006M01")	3.44E-06	2.92E-06	1.179675	0.2416

R-squared	0.679885	Mean dependent var	-7.87E-06
Adjusted R-squared	0.668029	S.D. dependent var	0.001112
S.E. of regression	0.000640	Akaike info criterion	-11.82279
Sum squared resid	3.32E-05	Schwarz criterion	-11.70784
Log likelihood	506.4684	Hannan-Quinn criter.	-11.77655
F-statistic	57.34463	Durbin-Watson stat	1.973837
Prob(F-statistic)	0.000000		

Date: 03/04/18 Time: 20:51
Sample: 2006M01 2015M01
Included observations: 87

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
**| . |	**| . |	1	-0.302	-0.302	8.2167	0.004
. |** |	. |*. |	2	0.269	0.196	14.805	0.001
.*| . |	. | . |	3	-0.095	0.034	15.629	0.001
. | . |	. | . |	4	0.021	-0.054	15.669	0.003
.*| . |	.*| . |	5	-0.081	-0.089	16.292	0.006
. | . |	. | . |	6	0.014	-0.015	16.311	0.012

**|. |	.*|. |	7	-0.207	-0.200	20.451	0.005
.|*. |	.|. |	8	0.154	0.065	22.777	0.004
.*|. |	.|. |	9	-0.139	-0.004	24.708	0.003
.|. |	.|. |	10	0.054	-0.051	25.004	0.005
.|. |	.|*. |	11	0.065	0.102	25.437	0.008
.*|. |	.*|. |	12	-0.148	-0.153	27.706	0.006

Null Hypothesis: D(DOLLAR) has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on AIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.058071	0.0000
Test critical values:	1% level	-2.592452	
	5% level	-1.944666	
	10% level	-1.614261	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DOLLAR,2)
Method: Least Squares
Date: 03/04/18 Time: 20:53
Sample (adjusted): 2006M04 2013M04
Included observations: 85 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DOLLAR(-1))	-1.047092	0.172842	-6.058071	0.0000
D(DOLLAR(-1),2)	-0.219299	0.109083	-2.010378	0.0476

R-squared	0.673132	Mean dependent var	-7.87E-06
Adjusted R-squared	0.669193	S.D. dependent var	0.001112
S.E. of regression	0.000639	Akaike info criterion	-11.84897
Sum squared resid	3.39E-05	Schwarz criterion	-11.79149
Log likelihood	505.5811	Hannan-Quinn criter.	-11.82585
Durbin-Watson stat	1.991415		

Date: 03/04/18 Time: 20:55
Sample: 2006M01 2015M01
Included observations: 87

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
**|. |	**|. |	1	-0.302	-0.302	8.2167	0.004
.|** |	.|*. |	2	0.269	0.196	14.805	0.001

.*|. |	.|. |	3	-0.095	0.034	15.629	0.001
.|. |	.|. |	4	0.021	-0.054	15.669	0.003
.*|. |	.*|. |	5	-0.081	-0.089	16.292	0.006
.|. |	.|. |	6	0.014	-0.015	16.311	0.012
**|. |	.*|. |	7	-0.207	-0.200	20.451	0.005
.|*. |	.|. |	8	0.154	0.065	22.777	0.004

Null Hypothesis: D(FREE_RISK) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on AIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.438113	0.0000
Test critical values:	1% level	-3.508326	
	5% level	-2.895512	
	10% level	-2.584952	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(FREE_RISK,2)
Method: Least Squares
Date: 03/04/18 Time: 21:00
Sample (adjusted): 2006M03 2013M04
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FREE_RISK(-1))	-0.794212	0.106776	-7.438113	0.0000
C	-1.15E-05	0.000144	-0.080255	0.9362

R-squared	0.397095	Mean dependent var	2.33E-06
Adjusted R-squared	0.389918	S.D. dependent var	0.001705
S.E. of regression	0.001332	Akaike info criterion	-10.38151
Sum squared resid	0.000149	Schwarz criterion	-10.32443
Log likelihood	448.4050	Hannan-Quinn criter.	-10.35854
F-statistic	55.32553	Durbin-Watson stat	1.989305
Prob(F-statistic)	0.000000		

Date: 03/04/18 Time: 21:01
Sample: 2006M01 2015M01
Included observations: 87

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.|*. |	.|*. |	1	0.206	0.206	3.8122	0.051

. |. |	. |. |	2	0.020	-0.024	3.8480	0.146
. |*. |	. |*. |	3	0.195	0.205	7.3611	0.061
. |. |	.*|. |	4	-0.055	-0.151	7.6476	0.105
.*|. |	. |. |	5	-0.107	-0.058	8.7325	0.120
**|. |	**|. |	6	-0.235	-0.273	14.013	0.029
.*|. |	. |. |	7	-0.142	0.003	15.956	0.026
. |. |	. |. |	8	0.006	0.049	15.960	0.043
. |*. |	. |*. |	9	0.075	0.191	16.514	0.057
. |*. |	. |*. |	10	0.139	0.103	18.459	0.048
. |. |	. |. |	11	0.047	-0.062	18.687	0.067